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AUTHOR	Clark, Julia V.
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ABSTRACT

Looking to the year 2000 and beyond, this digest explores the lack of individuals entering the fields of science, especially underrepresented minority students such as Blacks, Hispanics, and American Indians. Sections include: (1) "Changing Demographics"; (2) "Status of Minorities in Science"; (3) "Barriers to Success"; (4) "Transforming Teaching and Learning"; (5) "Suggestions for Teachers"; (6) "Parental Involvement"; and (7) "The Challenge." (CCM)

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While the nation is concerned about the shortage of teachers at the K-12 grade levels, especially in science and mathematics, there is also continuous concern about attracting and retaining more students in these subject areas. Looking to the year 2000 and beyond, we face the potential of a serious shortfall in the number of individuals entering the fields of science and mathematics. This is especially true for underrepresented minority students (Blacks, Hispanics, and American Indians). In the years ahead, these underrepresented minorities will constitute a growing population within the pool of students from which a highly skilled workforce will be drawn.

Minorities are underrepresented at every level from elementary to graduate school. Lack of preparation in science among under-represented minority groups in the early elementary grades undermines enrollment and success in secondary-level school programs and, ultimately, in college and career choices later in life.

As the nation's economic base shifts increasingly toward technology, participation and achievement in science and mathematics among minority students become increasingly important. Unfortunately, minority students, those who form the most rapidly growing portion of our school-age population, are the ones that are most left out of science and mathematics. By not studying these subjects, both the minority students and the United States as a whole stand to lose. The minority students are depriving themselves of many career choices, including the skilled technical and computer-oriented occupations as well as access to white male-dominated, high salaried occupations. Further,a basic understanding of science and mathematics is essential for all students, not only those pursuing careers in scientific and technical fields. Adequate preparation in science and mathematics enables students to develop intellectually and socially, and participate fully in a technological society as informed citizens (Clark, 1996). The United States can meet future potential shortfalls of scientists and engineers only by reaching out and bringing members of underrepresented minorities into science and engineering. America's standing and competitiveness depend on it (Task Force on Women, Minorities, and the Handicapped in Science and Technology, 1988).

Changing Demographics

Differing fertility rates, immigration patterns, and age distributions, and thus death rates, of population subgroups suggest that the 21st century profile will contrast sharply with that of the 20th century. If the pattern continues, around the year 2030 the total elementary-school-age cohort of the United States could be about equally divided between Whites and all other racial and ethnic groups combined. Over the next 20 years, Blacks, Hispanics, American Indians, and Asian Americans would together outnumber the total White population of elementary school children ((Hodgkinson, 1992). The composition of this projected workforce causes great concern in the scientific community and suggests that the United States must make greater efforts in increasing the proportion of minorities choosing careers in science.

Status of Minorities in Science

Too few minorities (Blacks, Hispanics and Native Americans) are represented among the population of scientists in the United States. Despite substantial gain over the past decade, minorities are still underrepresented in science and engineering, both in employment and training (NSF, 1996).

Data from the National Science Foundation (NSF, 1994) indicate that in 1990, racial and ethnic minorities constituted 22% of the civilian labor force but only 14% of the science and engineering labor force. Underrepresented minorities (Blacks, Hispanics, and American Indians) represented 19% of the total labor force and 8% of the science and engineering labor force. Asian Americans were well represented in the science and engineering labor force, at 3% of the total labor force and 6% of the science and engineering labor force. Women made up 46% of the labor force in all occupations, but only 22% of the science and engineering labor force.

In the year 2000, it is projected that 85% of new entrants to the workforce in the United States will be females and members of minority groups. Based on this percentage, the goal should be clear. Both groups should be represented in the scientific and technology professions in proportion to their presence in the population as a whole.

Although Blacks demonstrated significant progress during the decade from 1980 to 1990, in both science and math courses taken and in student achievement, they continue to be underrepresented in the science and engineering labor forces. Hispanics also remain underrepresented, with little progress being made during the past decade (NSF, 1994). Limited statistics available on American Indians in the labor force suggest that they too are underrepresented in science and engineering.

Barriers to Success

Factors contributing to unequal participation of minorities in science and mathematics education include understaffed and under-equipped schools—usually found in minority communities—tracking, judgments about ability, number and quality of science and mathematics courses offered, access to qualified teachers, access to resources, and curricula emphasis (NSF, 1996) Inequities in school funding can also highlight the social context of schooling. Schools, particularly secondary schools, in urban areas with a high proportion of economically disadvantaged or a high proportion of minority students offer less access to science and mathematics education.

According to NSF (1996), being labeled by ability is very important to student achievement because teachers tend to have different expectations of students in the various groups. Teachers of "high-ability" classes are more likely than those of "low-ability" classes to emphasize the development of reasoning and inquiry skills. Students in "low-ability" classes are more likely to read from a textbook and spend time doing worksheet problems and less likely to be asked to write reasoning about solving a mathematics problem and participate in hands-on science activities.

Minority students also have less access to qualified teachers. Math classes with higher proportions of minorities are less likely than those with lower proportions of minorities to have teachers with majors in the mathematics.

The instructional emphasis in largely minority classes are likely to differ as well. The teachers in science and mathematics classes having a high minority enrollment are more likely to emphasize preparing students for standardized tests and are less likely than those in classes having fewer minority students to emphasize preparing students for further study in science or mathematics.

All too often, at the elementary school level, usually around the middle school grades, many students, especially minority students, learn to dislike or fear science and mathematics and take only the minimum required courses in these subjects at the junior and senior high school levels. The damage done is incalculable. They emerge from elementary and secondary schools without an adequate grounding in science and mathematics. Even if they become interested in the subjects in later grades, it is often too late to take the courses necessary to pursue careers in the fields of science and mathematics in college.

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Transforming Teaching and Learning

To ensure that all students receive an appropriate, high-quality science and mathematics education, measures should be taken by educators to ensure that underrepresented minorities have improved opportunities and greater encouragement to participate fully in science and mathematics education. Curricular and instructional methodologies need to be updated to include cooperative learning and accommodate alternative learning styles. The science program should be designed to foster enthusiasm, interest, and competence both for pursuing careers in the field and for the acquisition of skills and knowledge demanded by an increasingly technological society.

Suggestions for Teachers

For effective science and mathematics teaching, the teacher should:

- Incorporate manipulative materials and hands-on activities as regular instructional strategies. Provide opportunities for students to engage in problem-solving inquiry-based activities.
- Have high expectations in science and mathematics for all students.
- Encourage and challenge all students. Provide experience that will challenge the students intellectually.
- Involve all students in classroom activities and discussions. Present science as a subject that everyone can learn.
- Employ a variety of teaching styles and strategies. Modify and adapt materials and learning to allow the fullest possible participation of all students.
- Provide opportunities for students to learn how science and mathematics are applicable to daily living and valuable to future education and employment. Encourage all students to apply classroom learning to practical situations. Also, help students connect life experiences to learning experiences.
- Make provisions for as much individualization as possible. Provide cooperative learning activities that will provide students opportunities to associate with each other, learn from each other, and gain respect for each other.
- Involve appropriate role models in career exploration activities.
- Encourage parents' interest in promoting science and mathematics.

It is important for teachers to help students develop to their maximum potentials by involving them in classroom experiences that will (a) challenge them intellectually, and (b) prepare them for a life of continuous learning. Without sufficient instruction, many students, whether they are slow learners, average, gifted, or from other exceptional groups, will show little interest in science and mathematics. They will eventually "turn off" to science and mathematics and never realize their potential in these subjects.

Parental Involvement

There are several things that every parent should know about science and mathematics classes. Among them are:

- Given support and encouragement, all students can perform well in science and mathematics courses.
- All students should take science and mathematics courses every year.
- Students learn science best through hands-on experiences.

Here are ways parents can guide children toward excellence in science and mathematics:

- Get involved in creative educational programs in the community. (a) Visit the museum. There are a variety of exhibits and classes held for children and their parents at museums. (b) Check local colleges and universities for summer science and mathematics programs or information about science and mathematics programs for school-age children. There are several National Science Foundation (NSF) funded programs designed to help children develop an understanding of science and mathematics. These programs emphasize "hands-on" experimentation and exploration.
- Encourage children to read about science. Check the local library for books about science and easy-to-do science projects.
- Watch science TV with children. There are several good science programs on television, such as National Geographic Specials, NOVA, Nature, and Bill Nye-The Science Guy, designed specifically for children. As parents watch with their children, they should help them ask questions and understand the concepts presented.
- Shop for items for home science. Go to museums and bookstores and look at science books for children. Look for books that have science activities in them.
- Encourage natural curiosity. Share informal education activities frequently through visits to zoos, museums, and local high technology companies. Go to toy stores and look for games that encourage children to think, ask questions, test solutions, etc.

All students, minority students in particular, need to know the importance of science and mathematics in their daily lives. Knowledge of these subjects help them to develop intellectually and socially. Science is a way of thinking, a way of understanding the world. Minority students need to understand that early involvement with the substance of science and mathematics can open gates for them into all the domains of knowledge and employment. Science and mathematics are shaping the future; studying these subjects prepares them for a place in that future.

The Challenge

Teachers are called on to provide quality education to all children and prepare them to live and work in a world transformed by rapid growth in new technologies, international competitiveness, economic globalization, and increasing demographic shifts. Americans must become aware that future shortfalls of scientists and engineers can only be met by bringing minorities into the pool of science and mathematics majors. As a new century approaches, the promise made by America and articulated by Franklin D. Roosevelt over a half century ago must be reclaimed: "We seek to build an America where no one is left out." America must ensure that all children receive a quality education and have access to economic opportunities (Quality Education for Minority Project, 1990).

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National Science Foundation. (1994). *Women, minorities, and persons with disabilities in science and engineering*. Washington, DC.

Quality Education for Minorities (QEM) Network. (1990). *Education that works: An action plan for the education of minorities*. Cambridge: MIT, QEM Network.

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World Wide Web Resources

Quality Education for Minorities Network
http://qemnetwork.qem.org

Women and Minorities in Science and Engineering
http://www.ai.mit.edu/people/ellens/Gender/wom_and_min.html

SUMMA (Strengthening Underrepresented Minority Mathematics Achievement (SUMMA) Program of the Mathematical Association of America)
http://www.maa.org/summa/archive/summa_wl.htm

Equity
http://www.serve.org/Eisenhower/equity.html

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